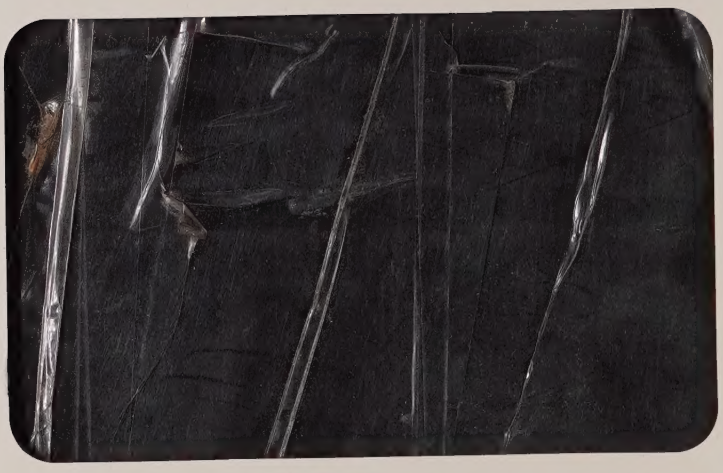
PHOTODYNE INC.

MODEL 1710/1720
LASER SOURCE
MODULE

INSTRUCTION MANUAL



MODEL 1710/1720
LASER SOURCE
MODULE

NOTICE OF PROPRIETARY RIGHTS

THE DESIGN CONCEPTS AND ENGINEERING DETAILS EMBODIED IN THIS MANUAL, WHICH ARE THE PROPERTY OF PHOTODYNE, INC., ARE TO BE MAINTAINED IN STRICT CONFIDENCE; NO ELEMENT OR DETAIL OF THIS MANUAL IS TO BE SPURIOUSLY USED, NOR DISCLOSED, WITHOUT THE EXPRESS WRITTEN PERMISSION OF PHOTODYNE INC. ALL RIGHTS ARE RESERVED. NO PART OF THIS PUBLICATION MAY BE REPRODUCED, STORED IN A RETRIEVAL SYSTEM, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC,, MECHANICAL, PHOTOCOPYING, RECORDING, OR OTHERWISE, WITHOUT PRIOR WRITTEN PERMISSION FROM PHOTODYNE INC.

© COPYRIGHT 1986, PHOTODYNE INC.

FOURTH PRINTING, OCTOBER 1987, NEWBURY PARK, CALIFORNIA
UNITED STATES OF AMERICA

Caution

THE PERFORMANCE OF THIS INSTRUMENT IS HIGHLY DEPENDENT ON PRESERVING THE ORIGINAL QUALITY OF THE CONNECTOR INTERFACE. OBSERVE THE FOLLOWING THE PRECAUTIONS:

1) THE OPTICAL PORT(S) MUST BE KEPT COVERED AT ALL TIMES WHEN NOT IN USE.

2) ALL DUST PARTICLES AND OTHER CONTAMINANTS MUST BE EXCLUDED FROM THE OPTICAL PORT(S). WE RECOMMEND USING A LINTLESS CLOTH AND ALCOHOL TO CLEAN THE POLISHED END OF THE CONNECTOR.

3) INTERFACES TO THE INSTRUMENT MUST HAVE HIGH QUALITY TERMINATIONS WITH CONNECTORS PERFECTLY COMPATIBLE WITH THE MANUFACTURER'S TYPE AS GIVEN IN THE PHOTODYNE SPECIFICATIONS. THESE ARE HIGHLIGHTED IN THE TABLE BELOW.

NOTE: DAMAGE INCURRED AS A RESULT OF IGNORING THIS CAUTION WILL BE AT THE LIABILITY OF THE USER.

SUFFIX	MANUFACUTURER AND TYPE	SINGLE MODE	MULTIMODE
A	AMP SIMPLEX	---	501067-2
B	AMPHENOL 905/906 SMA	---	906-110-XXXX
G	DIAMOND/INTEROPTICS	HMS-3	GFS-3
H	HOLTEK 38000/STRATOS 430	---	38066
J	SEIKO FC/D3	SF-1A/SAP-1	SF-1B/SAP-2
M	DIAMOND/SIEMENS DIN 47256	D-2106	D-236
N	NEC D4	OD-9474	OD-9470
P	SEIKO/NTT FC TYPE PC	SF-1A/SAP-1	SF-1B/SAP-2
R	RADIALL OPTABALL	F714 (VFO)	F710 (PFO)
S	SIRTI BAYONET BICONIC	FC1F-/MB1	FCAF-/MBx
T	AT&T ST	P3020A-C-125	P2020A-C-125
W	AT&T BICONIC	1016A/2016A	1006A

NOTE: FOR REFERENCE PURPOSES, ALL MANUFACTURER'S PART NUMBERS ARE SHOWN FOR 125μM CLADDING DIAMETER FIBER.

FN: CAUTION.ERR REV D 01/88

PHOTODYNE INC.
1175 Tourmaline Drive
Newbury Park, California 91320 U.S.A.
Phone: (818) 889-8770 / (805) 499-3636
Telex: 18 1159 FAX: 1-805-499-9311

Digitized by the Internet Archive
in 2026

https://archive.org/details/manualsplus_13017

TABLE OF CONTENTS

SECTION		PAGE
	List of Figures	iv
	Unique Features	vi
1.	**GENERAL INFORMATION**	1-1
1.1	Description	1-1
1.2	Features	1-4
1.3	Applications	1-4
1.4	Specifications	1-5
1.4.1	Definition of Stability	1-9
1.4.2	Definition of Wavelength and Spectral Width	1-11
1.5	Warranty Information	1-18
1.6	Limitation of Warranty	1-18
1.7	Statement of Calibration	1-19
1.8	Change Notice	1-19
2.	**INITIAL PREPARATION**	2-1
2.1	General	2-1
2.2	Inspection	2-1
2.3	Damaged In Shipment	2-1
2.4	Contents	2-2
2.5	Preparation for Use	2-3
2.6	Warm-Up Time	2-3

TABLE OF CONTENTS (cont.)

SECTION		PAGE
3.	**OPERATING INSTRUCTIONS**	3-1
3.1	General	3-1
3.2	How to Operate Model 1710/1720	3-1
3.3	Optical Power Modulation	3-2
4.	**THEORY OF OPERATION**	4-1
4.1	The Semiconductor Laser Diode	4-1
4.2	Block Diagram	4-5
4.2.1	Power	4-6
4.2.2	Power-On Delay	4-6
4.2.3	Modulation	4-6
4.2.4	Temperature	4-6
4.2.5	Output Power Adjust	4-7
4.2.6	Laser	4-7
4.2.7	Photodiode	4-7
4.2.8	Signal Out	4-8
4.2.9	Laser Current	4-8
4.2.10	PIN D-Connector	4-9
5.	**LASER SOURCE MODULE, MAINFRAME AND ACCESSORIES**	5-1
5.1	Laser Source Module	5-1
5.2	Mainframes	5-2
5.3	Cable Assemblies	5-3
5.4	Accessories	5-4

TABLE OF CONTENTS (cont.)

SECTION		PAGE
6.	**SAFETY CONSIDERATIONS**	6-1
	6.1 General	6-1
	6.2 Laser Safety	6-1
	6.3 Test Procedure for Laser Safety Qualification	6-2
	6.4 Calibration Procedure for PHOTODYNE Model 550 Sensor Head	6-6
7.	**MAINTENANCE AND REPAIR**	7-1
	7.1 Maintenance and Repair	7-1
	7.2 Performance Verification	7-1
	7.3 Calibration	7-2
	7.4 Statement of Spectral Calibration	7-3
	7.5 Statement of Electrical Calibration	7-5

LIST OF FIGURES

NO.		PAGE
1.1	Typical Lens Arrangement used in the 1710/1720 Source Module	1-2
1.2	Laser Driver with one Feedback Loop	1-10
1.3	Stability Measurement Setup	1-10
1.4	Plot of Stability of a 1710-1300-W	1-11
1.5	Wavelength Measurement Setup	1-12
1.6	Plot of Wavelength	1-12
1.7	Well behaved laser at low operating current	1-13
1.8	Wavelength vs. Temperature for InGaAsP Diode	1-14
1.9	Spectral Emission with low reflecting fiber coupled to the Laser	1-15
1.10	Spectral Emission with high reflecting fiber attached to the Laser	1-15
2.1	Contents of Model 1710/1720 when received	2-2
3.1	Optical Power Modulation	3-2
3.2	Modulation Setup	3-3
4.1	The double Heterojunction Laser and typical Spectral Emission	4-1
4.2	Index-guided Laser Structure	4-2
4.3	Typical Spectral Pattern of a 1710/1720-1300-X Laser	4-3
4.4	Power Output vs. Laser Current	4-3
4.5	Principle of an Optical Feedback Laser Driver	4-4
4.6	Block Diagram of Laser Driver	4-5
6.1	Measurement Setup	6-3

LIST OF FIGURES (cont.)

NO.		PAGE
6.2	ID-Label/Certification Label	6-4
6.3	Safety Data for Model 1710/1720	6-5
7.1	Sample of Certification of Calibration	7-6

UNIQUE FEATURES OF MODEL 1710/1720

ID/CERTIFICATION LABEL
* date of manufacture
* class specification

MODEL LABEL
* indicates the wavelength
* indicates the type of connector

MULTIPLE SAFETY
* yellow LED lights up, whenever the laser is active
* the laser comes on approximately 5 seconds after the power is on (operator safety)
* a protection circuit will disable the laser if the temperature inside the case exceeds 45°C.

POWER ON DELAY
* the red LED lights up whenever the power is on.
* the mainframe has a key switch for operator safety

POWER OUTPUT CONTROL

a potentiometer allows the user to vary the optical output power over a 10dB range

LASER OUTPUT FIBER OPTIC CONNECTOR OPTIONS

Several output fiber optic connectors can be supplied as options.

MULTIPLE PROTECTION FEATURES
* cap protects lens and optical output from dust
* cap with chain provides protection for user

1. GENERAL INFORMATION

1.1 Description

Fiber Optic Sources are required for accurate and stable attenuation measurements on fiber optic cables, splices and connectors. With the 1710/1720 Laser Source Modules, PHOTODYNE, INC. offers a new versatile way for a variety of measurement applications. The 1710/1720 modules are available in many different versions to cover the different wavelength bands used in fiber optics as well as all of the most popular connector interfaces. The laser modules are used for attenuation measurements requiring extreme dynamic ranges or where narrow spectral and coherent light is required. The lasers are the most powerful sources available.

A new way of coupling power into the fiber core is incorporated in the small 80 cubic cm module. Instead of coupling the light directly to a fiber and then terminating the fiber with a fiber optic connector to interface with the user's fiber, PHOTODYNE's source modules image the light emitting area on to the core of the user's fiber.

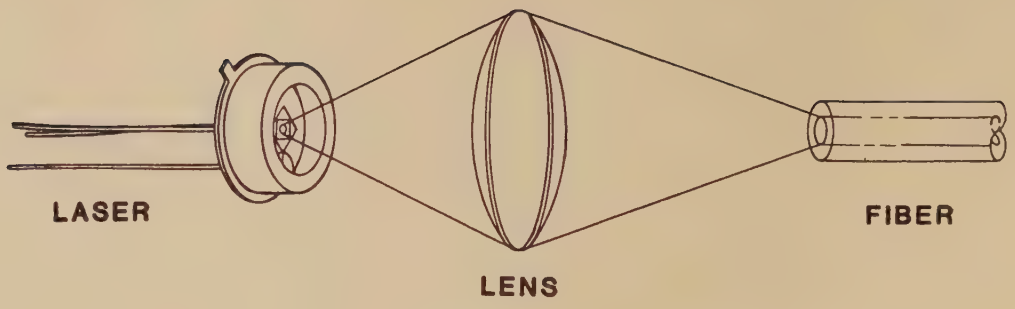


Figure 1.1 Typical lens arrangement used in the 1710/1720 Source Module

This arrangement insures maximum coupling efficiency even for different core sizes (i.e. more power in a larger core and less power in a small fiber core). There is no wear-out of the fiber optic connector or the source module connector because there is no mechanical contact between fiber end and coupling lens. Modern fibers are cladding mode stripping type fibers, thus only core light is propagated. When using fiber which does not strip the cladding light, then a cladding mode stripper must be used for better accuracy and repeatability. Repeatability is maintained to within the mechanical tolerance of the fiber optic connectors being used.

The module can be used for multimode fibers as well as for single-mode fibers. Most of the fiber optic connectors can be interfaced using this technology.

PHOTODYNE, INC. offers the 1710/1720 Laser Source Modules in several standard configurations.

Connector	Code	Central Wavelength
Amphenol SMA 905/906	(B)	850, 1300, 1550nm
Diamond/Interoptics	(G)	850, 1300, 1550nm
Holtek 38000/Stratos 430	(H)	850, 1300, 1550nm
Seiko FC/D3 (NTT)	(J)	850, 1300, 1550nm
Siemens DIN/Diamond	(M)	850, 1300, 1550nm
NEC D4	(N)	850, 1300, 1550nm
AT&T ST	(T)	850, 1300, 1550nm
AT&T Biconic	(W)	850, 1300, 1550nm

Model 1710 Central Wavelength ± 20nm

Model 1720 Central Wavelength ± 5nm

A built in potentiometer allows the user to vary the optical output power. A yellow indicator LED will light up whenever the laser is active. When a module is plugged-in to a PHOTODYNE instrument, such as the Model 2230XF Test Set, the laser current can be displayed. For operator safety every mainframe has a key switch to activate the laser power.

1.2 Features

* High Power Output
* Good Repeatability
* Single-Mode and Multimode Fiber Compatible
* Wide Wavelength Range available
* Easy and Fast Interchangeable
* Available for most Fiber Optic Connectors
* Adjustable Power Output
* Continuous Wave (CW) Output
* 0 to 2kHz Square Wave Modulation
* 0dBm into Multimode Fiber
* -10dBm into Single-Mode Fiber
* Class I Laser Product (USA)
* Module needs less than 50mA

1.3 Applications

* Line Trouble-Shooting
* Wavelength Multiplexing
* Calibration Transfer
* Attenuation Measurements
* Link Installation and Restoration

1.4 Specifications

SPECIFICATIONS FOR 17XX-0850-X

Specifications at 25°C	850 nm		
	MINIMUM	TYPICAL	MAXIMUM
Central Wavelength			
Model 1710-0850-X	830 nm	---	870 nm
Model 1720-0850-X	845 nm	---	855 nm
Wavelength vs Temperature	---	0.40 nm/°C	---
RMS Spectral Width	---	4 nm	6 nm
Power Launched into 50/125 GI, 0.20 NA	0 dBm (1000 uW)	+2.0 dBm (1600 uW)	+2.7 dBm (1900 uW)
Power Launched into 9/125, 0.11 NA	---	---	---
Power vs Temperature	---	-0.02 dB/°C	---
Stability:			
1 hour (NOTE 1)	---	±0.10 dB	---
24 hours (NOTE 2)	---	±0.20 dB	---
Repeatability (NOTE 3):			
50/125 MM, Non-SMA	---	0.2 dB	---
50/125 MM, SMA	---	1.0 dB	---
Temperature:			
Operating	0°C	---	+ 40°C
Storage	-40°C	---	+ 70°C
Laser Shutdown	+45°C	+47°C	+ 50°C

NOTES 1) Minimum warm up period of 15 minutes in 7600XR at 75% of Maximum Output Power.
2) Minimum warm up period of 60 minutes in 7600XR at 75% of Maximum Output Power.
3) Defined as the Standard Deviation of multiple insertions of the same connector. Connector must be terminated to the manufacturer's specifications.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SPECIFICATIONS FOR 17XX-1300-X

Specifications at 25°C	1300 nm		
	MINIMUM	TYPICAL	MAXIMUM
Central Wavelength			
Model 1710-1300-X	1280 nm	---	1320 nm
Model 1720-1300-X	1295 nm	---	1305 nm
Wavelength vs Temperature	---	0.45 nm/°C	---
RMS Spectral Width	---	2 nm	4 nm
Power Launched into 50/125 GI, 0.20 NA	0 dBm (1000 uW)	+2.0 dBm (1600 uW)	+2.7 dBm (1900 uW)
Power Launched into 9/125, 0.11 NA	-10 dBm (100 uW)	-5.2 dBm (300 uW)	-2.2 dBm (600 uW)
Power vs Temperature	---	-0.02 dB/°C	---
Stability:			
1 hour (NOTE 1)	---	±0.10 dB	---
24 hours (NOTE 2)	---	±0.20 dB	---
Repeatability (NOTE 3):			
50/125 MM, Non-SMA	---	0.2 dB	---
50/125 MM, SMA	---	1.0 dB	---
09/125 SM, Non-SMA	---	1.5 dB	---
Temperature:			
Operating	0°C	---	+ 40°C
Storage	-40°C	---	+ 70°C
Laser Shutdown	+45°C	+47°C	+ 50°C

NOTES 1) Minimum warm up period of 15 minutes in 7600XR at 75% of Maximum Output Power.
2) Minimum warm up period of 60 minutes in 7600XR at 75% of Maximum Output Power.
3) Defined as the Standard Deviation of multiple insertions of the same connector. Connector must be terminated to the manufacturer's specifications.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

1720-1310-X, LASER SOURCE MODULE, 1310nm (at 25°C)

	MIN.	TYP.	MAX.
Central Wavelength: Model 1720-1310-X:	1305 nm	1310 nm	1315 nm
Power into 50/125um, 0.2 NA	1000 uW 0 dBm	1600 uW +2.0 dBm	1900 uW +2.7 dBm
Power into 9/125um, 0.1 NA	100 uW -10 dBm	300 uW -5.2 dBm	600 uW -2.2 dBm
Spectral Bandwidth (RMS):	---	2 nm	4 nm
Spectral Wavelength Accuracy	---	---	1 nm
Stability: 5 min. warm up 1 hour 24 hours	 --- ---	 ±0.05 dB ±0.15 dB	 ±0.10 dB ±0.20 dB
Temperature: operation storage Laser shut down	0 °C -40 °C +45 °C	--- --- +47 °C	+40 °C +70 °C +50 °C
Repeatability: (Note 1) 50/125 um, 0.2 NA 9/125 um, 0.1 NA	 --- ---	 ± 0.1 dB ± 0.8 dB	 ± 0.3 dB ± 2.0 dB
Power vs. Temperature	---	0.01 dB/C	0.02 dB/C
Wavelength vs. Temp.	---	0.35 nm/C	0.45 nm/C
Laser-On Delay	5 sec		---

NOTE 1: Connector terminated to manufacturer's specifications

SPECIFICATIONS FOR 17XX-1550-X

Specifications at 25°C	1550 nm		
	MINIMUM	TYPICAL	MAXIMUM
Central Wavelength			
Model 1710-1550-X	1530 nm	---	1570 nm
Model 1720-1550-X	1545 nm	---	1305 nm
Wavelength vs Temperature	---	0.45 nm/°C	---
RMS Spectral Width	---	3 nm	7 nm
Power Launched into 50/125 GI, 0.20 NA	0 dBm (1000 uW)	+2.0 dBm (1600 uW)	+2.7 dBm (1900 uW)
Power Launched into 9/125, 0.11 NA	-10 dBm (100 uW)	-5.2 dBm (300 uW)	-2.2 dBm (600 uW)
Power vs Temperature	---	-0.04 dB/°C	---
Stability:			
1 hour (NOTE 1)	---	±0.15 dB	---
24 hours (NOTE 2)	---	±0.40 dB	---
Repeatability (NOTE 3):			
50/125 MM, Non-SMA	---	0.2 dB	---
50/125 MM, SMA	---	1.0 dB	---
09/125 SM, Non-SMA	---	1.5 dB	---
Temperature:			
Operating	0°C	---	+ 40°C
Storage	-40°C	---	+ 70°C
Laser Shutdown	+45°C	+47°C	+ 50°C

NOTES 1) Minimum warm up period of 15 minutes in 7600XR at 75% of Maximum Output Power.
2) Minimum warm up period of 60 minutes in 7600XR at 75% of Maximum Output Power.
3) Defined as the Standard Deviation of multiple insertions of the same connector. Connector must be terminated to the manufacturer's specifications.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

All modules are shipped packaged in cushioned plastic boxes.

Box:	Weight:	0.12kg	(4oz.)
	Height:	73mm	(2.9in.)
	Width:	135mm	(5.3in.)
	Depth:	93mm	(3.6in.)
Module:	Weight:	0.135kg	(4.5oz.)
	Height:	46mm	(1.8in.)
	Width:	46mm	(1.8in.)
	Depth:	96mm	(3.8in.)

1.4.1 Definition of Stability

To maintain a good stability the Model 1710/1720 uses an optical feedback loop in the circuit design. The laser emits light from both front and rear facets. The light from the rear mirror impinges on the monitoring photodiode in the circuit. As both front and rear beams are in constant proportion, the photodiode output current is used as an automatic feedback control of the drive current to the laser.

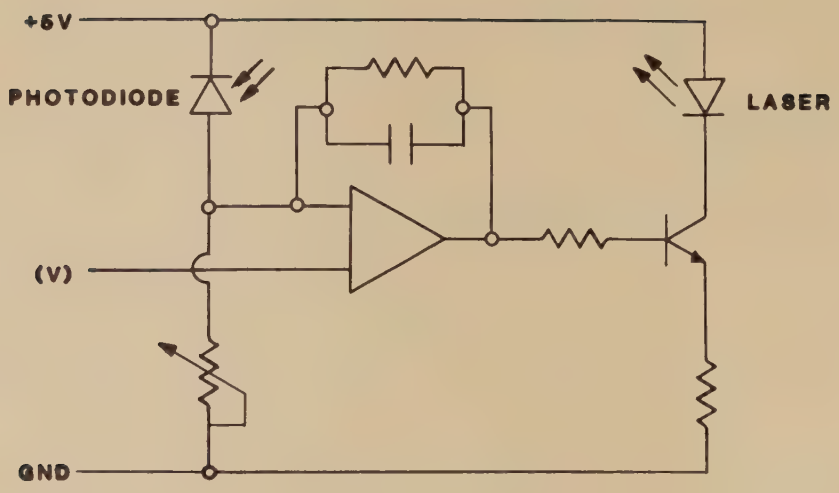


Figure 1.2 Laser Driver with Feedback Loop

Stability measurement procedure:

1) Setup as shown in Figure 1.3

2) Warm-up 15 minutes

3) Measurements every minute for 24 hours

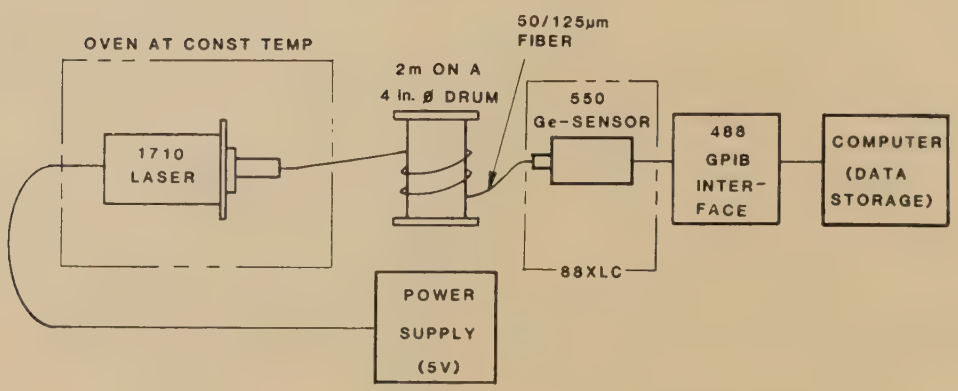


Figure 1.3 Stability Measurement Setup

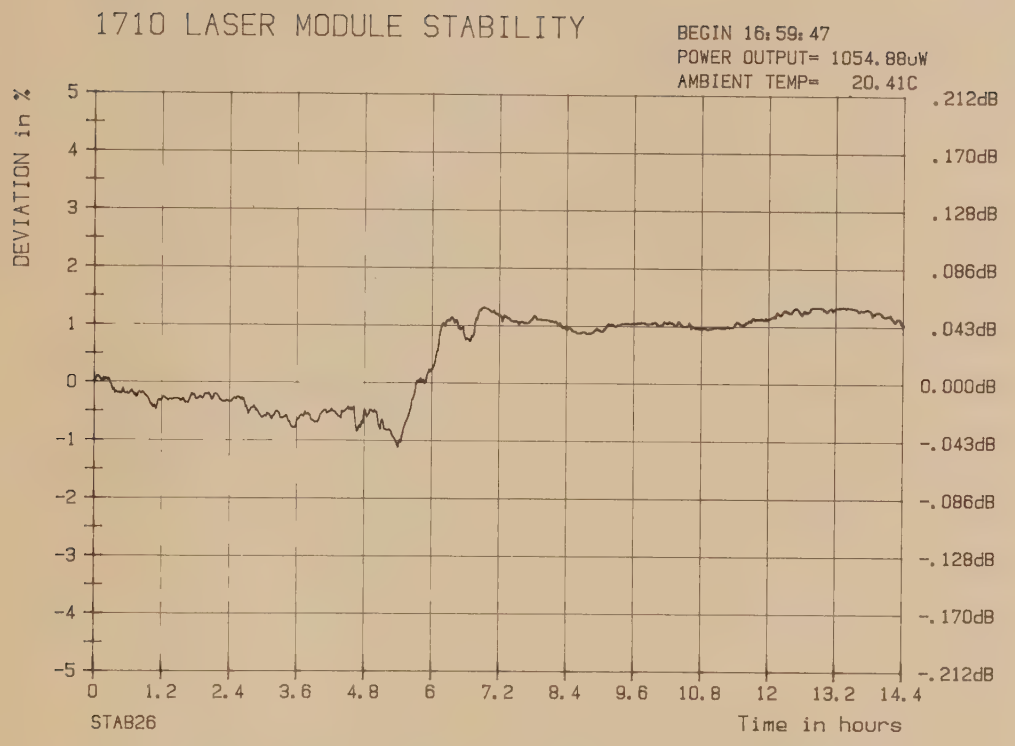


Figure 1.4 Plot of Stability of a 1710-1300-W

1.4.2 Definition of Wavelength and Spectral Width

Each Laser Source Module is supplied with an individual spectral calibration plot of intensity vs. wavelength, showing the source's actual central wavelength and spectral width.

Wavelength Measurement Procedure:

1) 1mW output power into 50/125um, 0.2NA
2) Room temperature
3) Setup as shown in Figure 1.5

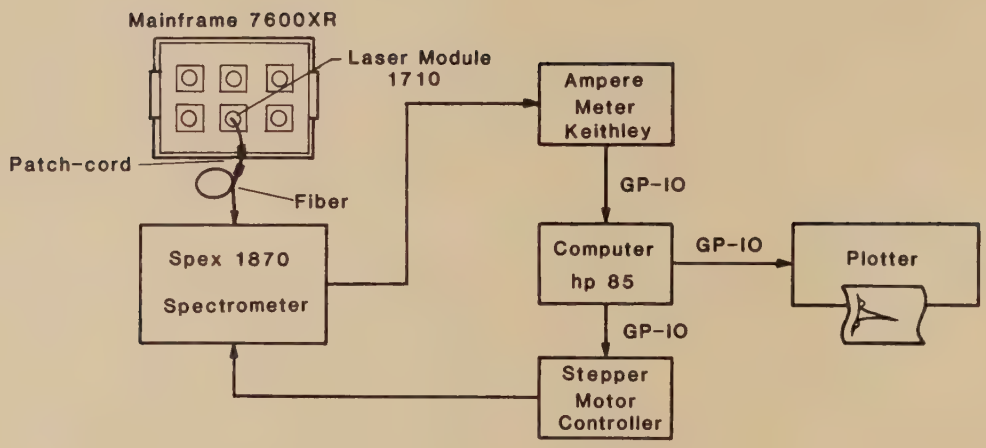


Figure 1.5 Wavelength Measurement Setup

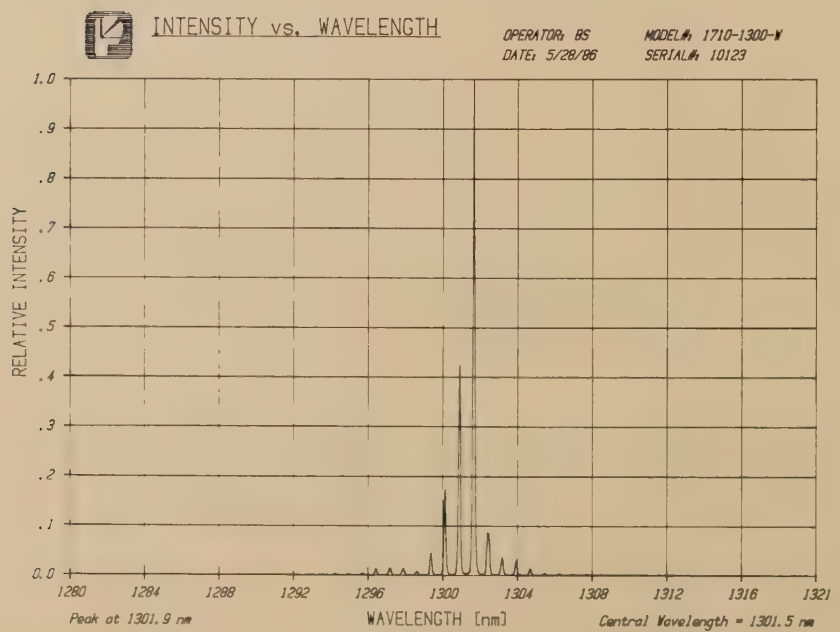


Figure 1.6 Plot of Wavelength

Semiconductor laser diodes usually exhibit many more than one longitudinal modes (Laser Lines). The amount of laser lines depends on several factors:

- Drive Current
- Temperature
- Modulation
- External Optical Stimulation

The drive current influences the laser as follows: Well above the threshold the laser usually has the fewest modes and only one dominant mode may be visible, representing an almost perfect laser. (See Figure 1.7).

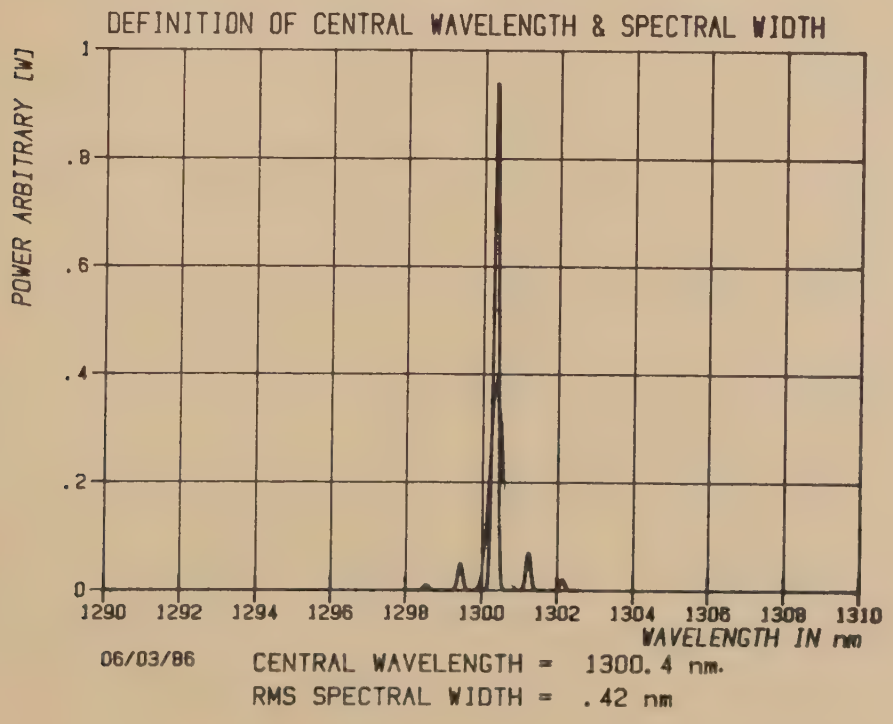


Figure 1.7. Well behaved laser at low operating current.

Temperature mostly affects the absolute wavelength of the laser. For InGaAsP material a temperature coefficient of 0.3nm/^{o}C is typical. (See Figure 1.8)

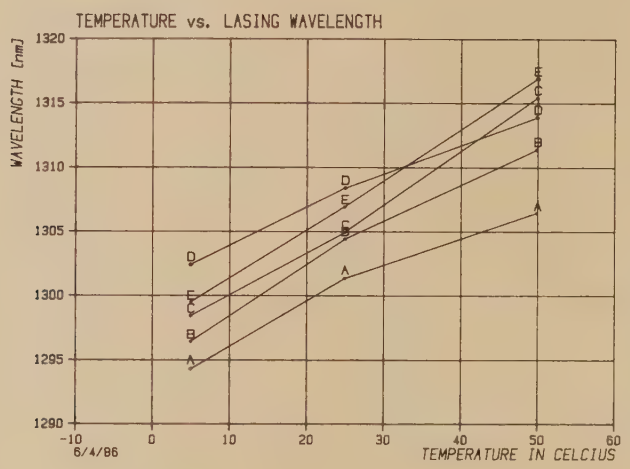


Figure 1.8. Wavelength vs. Temperature for InGaAsP Diode.

The modulation of the drive current affects the mode pattern of the laser. This phenomena is still being investigated and, due to the lack of proper instrumentation, only little information is available.

External optical stimulation of causes optical feedback and interference. A fiber coupled to the laser for example creates reflection and can be thought ofas an extension of the optical cavity. Altering the cavity can change the wavelength of the laser significantly - in most cases by enhancing low energy modes.
See Figures 1.9 and 1.10

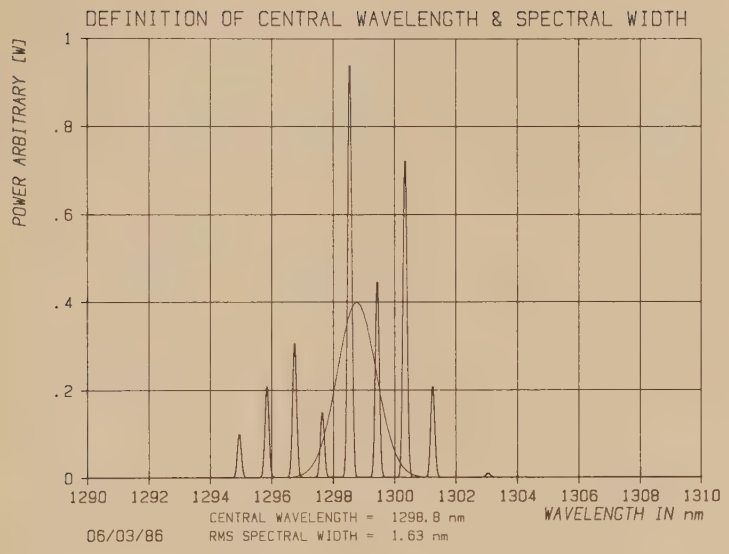


Figure 1.9. Spectral emission with low reflecting fiber coupled to the laser.

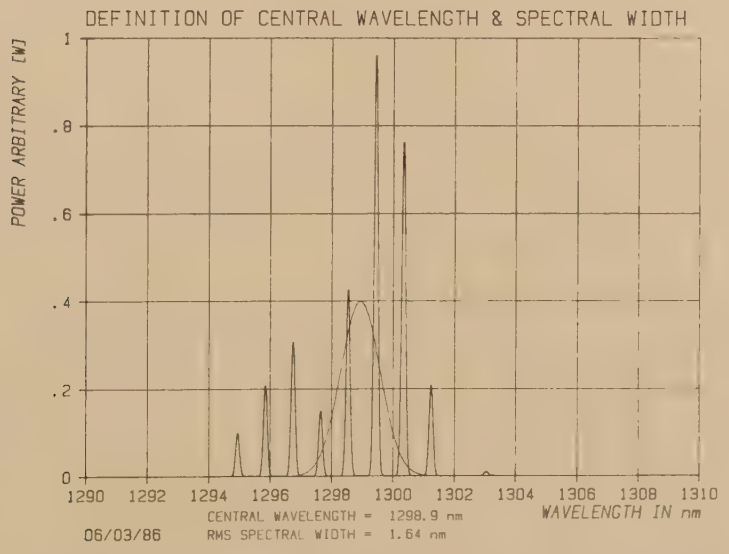


Figure 1.10. Spectral emission with high reflecting fiber attached to the laser.

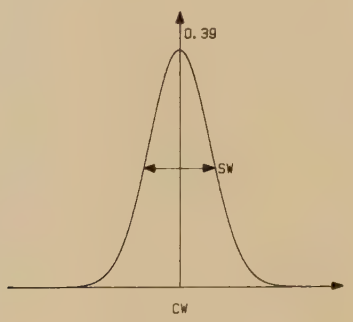
The above described problems make it difficult to characterize the wavelength emission and spectral width of the laser.

We can define the Central Wavelength and RMS Spectral width using Normal Distribution Law.

The formula for normal distribution is:

$$f_{(x)} = \frac{1}{\sqrt{2\pi}} \; e^{-\frac{x^2}{2}}$$

This represents the well known bell shaped curve:



Central Wavelength

The Central Wavelength is determined as the first moment of the wavelength from the power versus wavelength distribution. It can be calculated as follows:

$$CW = (1/P_o) \sum_{i=1}^{n} P_i \; \lambda_i$$

where:

CW = Central Wavelength

$P_o = \sum P_i$ = Total Power

P_i = Power of the i-th longitudinal mode

λ_i = Wavelength of the i-th longitudinal mode

Spectral Width (RMS)

The Spectral Width is determined as the root-mean-square (RMS) deviation of the wavelength for the wavelength versus power distribution. It can be calculated as follows:

$$SW = [[(1/P_o) \sum P_i \lambda_i^2] - (CW)^2]^{(1/2)}$$

where:

SW = RMS Spectral Width

CW = Central Wavelength

$P_o = \sum P_i$ = Total Power

P_i = Power of the i-th longitudinal mode

λ_i = Wavelength of the i-th longitudinal mode

Using the RMS value we can calculate the new normalized distribution shown as the bell shaped curve in the diagrams.

1.5 Warranty Information

PHOTODYNE, INC. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local PHOTODYNE Representative, or contact PHOTODYNE Headquarters in Newbury Park, California. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

1.6 Limitation of Warranty

This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability of fitness for a particular use. PHOTODYNE,

INC. shall not be liable for any indirect special or consequential damages.

1.7 Statement of Calibration

This module has been inspected and tested in accordance with specifications published by PHOTODYNE, INC. The accuracy and calibration of this module is traceable to the National Bureau of Standards through equipment which is calibrated at planned intervals by comparison to certified standards.

1.8 Change Notice

Improvements or changes to the module not incorporated into the manual will be explained on a yellow change notice sheet attached to the inside back cover of the manual.

2. INITIAL PREPARATION

2.1 General

This section provides information needed for incoming inspection and preparation for use.

2.2 Inspection

The unit was carefully inspected, both mechanically and electrically before shipment. When received, the shipping carton should contain the following items listed below. Account for and inspect each item before the carton is discarded. In the event of a damaged module write or call your local PHOTODYNE Representative or contact PHOTODYNE Headquarters in Newbury Park, California. Please retain the shipping carton in case reshipment is required for any reason.

2.3 Damaged In Shipment

All modules are insured when shipped by PHOTODYNE. If you receive a damaged module you should:

1) Report the damage to your shipper immediately.
2) Inform your local PHOTODYNE Representative or PHOTODYNE directly.
3) Save all shipping cartons.

Failure to follow this procedure may affect your claim for compensation.

2.4 Contents

1 Model 1710/1720 (wavelength and connector interface as ordered).

1 Instruction Manual for Model 1710/1720.

1 Warranty registration card (mail immediately after checking out the unit).

1 IR-Indicator

1 Key for Interlock

1 Trimmer Screwdriver

1 Spectral Data-Sheet

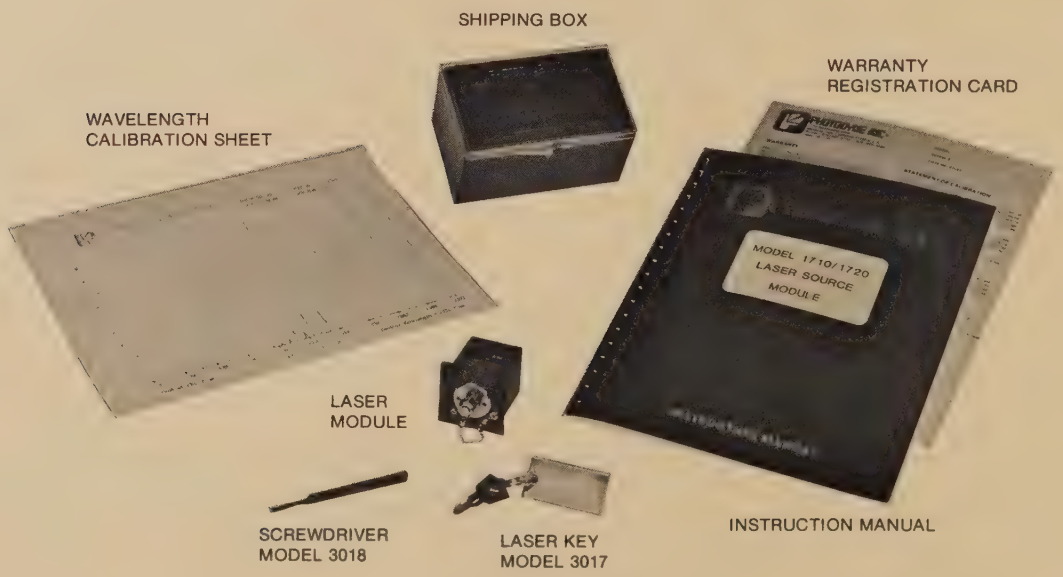


Figure 2.1 Contents of Model 1710/1720 when received.

2.5 Preparation for Use

The 1710/1720 Laser Source Module is shipped in a foam cushioned plastic box. The module is powered from a PHOTODYNE mainframe. Switch off the main instrument and remove the blank cover. It may be necessary to use a screwdriver to seperate the blank cover from the front panel of the mainframe. Pull out the cover by pressing the four prongs together.

Insert the module in the slot labeled "XMTR". (Transmitter and sensor modules are keyed so that they cannot be inserted in the wrong slot).

2.6 Warm-up Time

After the yellow LED (L-ON) turns ON, the user should allow at least 15 minutes for the laser to stabilize and operate within the specifications.

3. OPERATING INSTRUCTIONS

3.1 General

This section provides information needed to operate the 1710/1720 Laser Source Modules.

3.2 How to operate the Model 1710/1720

Turn on the instrument and turn on the "XTMR" (see instruction manual of the mainframe instrument). Turn the key-switch to power the module if the mainframe provides this feature. Use a jumper cable (such as the PHOTODYNE 1230 Series) to measure the output power of the 1710/1720 Laser Module.

DANGER

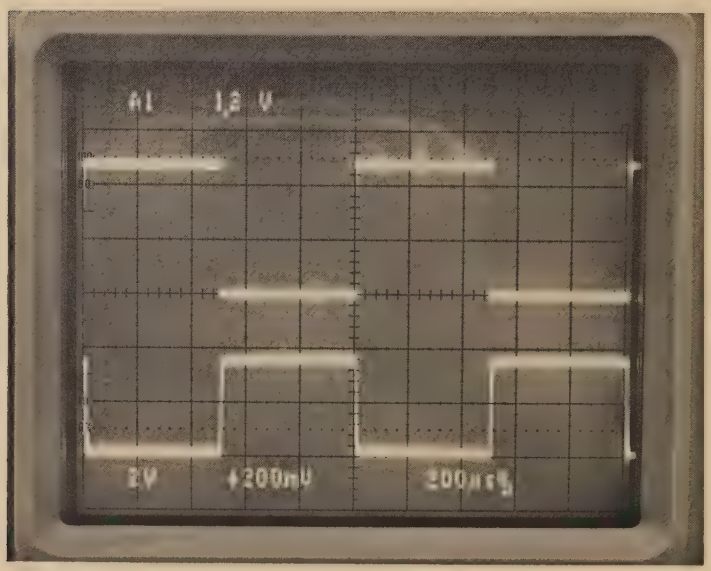
UNTERMINATED OPTICAL CONNECTORS MAY EMIT LASER RADIATION
DO NOT VIEW BEAM WITH OPTICAL INSTRUMENTS

A potentiometer on the front panel allows the user to vary the optical output power. Turn the output power adjust "P-Adj" fully clockwise to measure full output power or adjust the output power to the desired level. The laser power can be varied over an approximately 10dB range only. Notice, the maximum output power depends on the fiber diameter, the fiber N.A., the refractive index of the fiber and the quality of the connector interface.

Fiber optic connectors which are not rotation-keyed usually show a low repeatability, where as rotation-keyed connectors show a good repeatability. It may be necessary to rotate the non-keyed connectors until the best performance is obtained.

3.3 Optical Power Modulation

All the 1710/1720 Series Laser Source Modules have a modulation input on the rear 9 PIN D-Connector. A logical 1 signal turns the optical power off and a logical 0 signal (or open) turns the optical power on.



electrical input 1kHz

optical output 1kHz

Figure 3.1 Optical Power Modulation

Laboratory type instruments such as the 2230XR or 7600XR have an external modulation input which is directly connected to this modulation input.

Digital modulation in the range from 0 to 2kHz is easily done by applying a signal from 0 to 5V. If a TTL signal is used, a pull-up resistor should be connected to the + 5V to insure that the laser turns off completely.

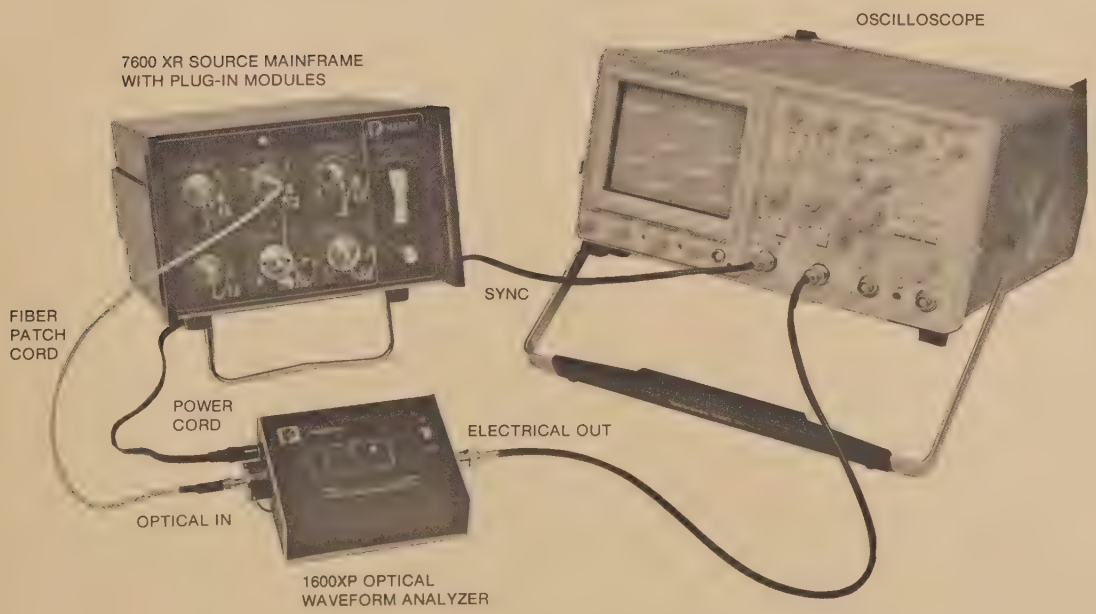


Figure 3.2 Modulation Setup

4. THEORY OF OPERATION

4.1 The Semiconductor Laser Diode

The main part in the 1710/1720 Laser Source Module is a semiconductor single transverse and multi wavelength laser diode. The function of a 1300nm laser diode is described. This general theory can be applied to all the semiconductor lasers used in the 1700series modules.

To achieve a high efficient singlemode semiconductor, the electron generated photons (light) must be confined to the active region, where it can stimulate more emission. The double heterojunction laser is such a laser having active regions as thin as 0.1um. This laser type can be operated in an efficient CW mode and is useful for multi-mode applications, since it generates many transverse and longitudinal modes.

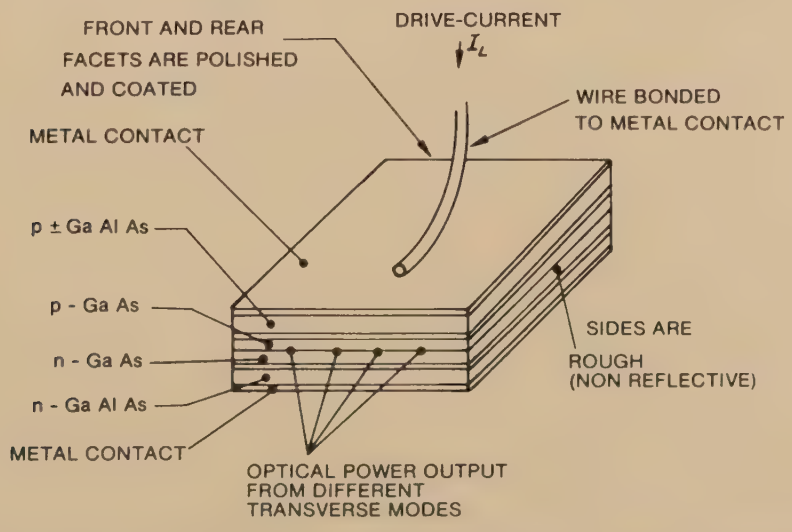


Figure 4.1 The double heterojunction laser and typical spectral emission.

To obtain a truly single mode laser the light beam must be confined horizontally as well. The Model 1710-1300-X/ 1720-1300-X employes an "INDEX GUIDED" LASER. The crystal is grown in a fashion that not only vertical wave guidance exists, but even horizontal boundaries of a lower refractive index material are constructed.

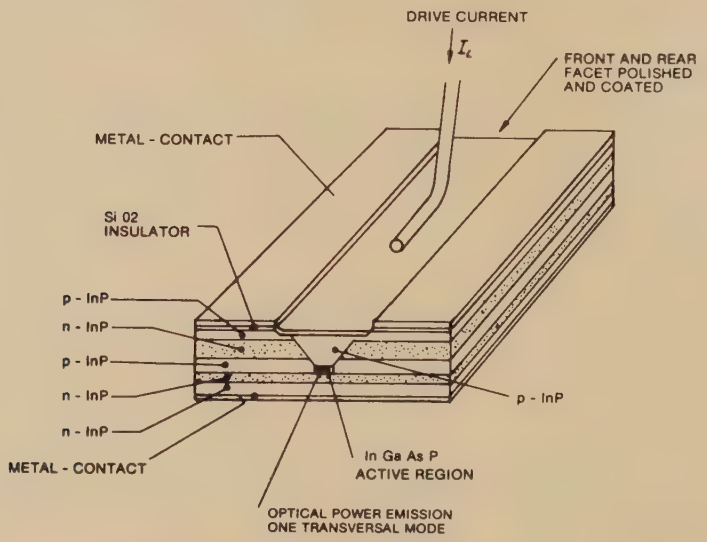


Figure 4.2 Index-guided Laser Structure

As can be seen, the cavity is a perfect waveguide and if constructed small enough, only one transverse mode is produced.

This device is capable of emitting at one single wavelength if the length and doping of the material are perfectly tuned. Practically there are always some side modes produced. Proprietary techniques structures can reduce this side mode effect to a minimum.

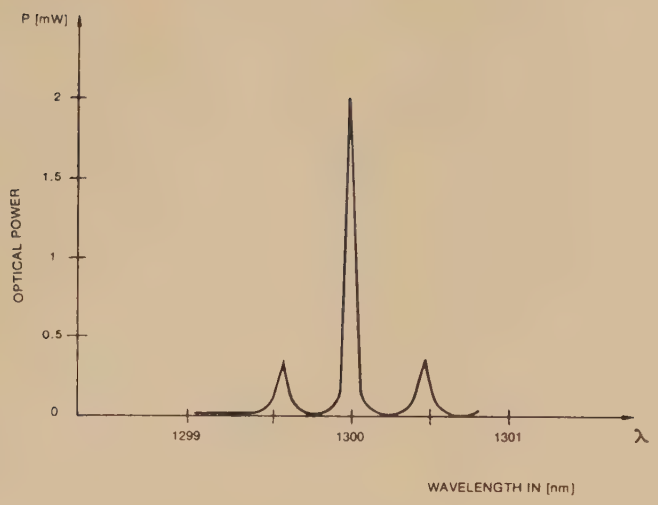


Figure 4.3 Typical Spectral Pattern of a 1710-1300-X/ 1720-1300-X Laser

The laser diode described above needs an operating current of only 30mA to 40mA at room temperature. One difficulty in using a laser diode is that the diode itself has a significant temperature dependence and therefore it is not easy to stabilize the device electronically.

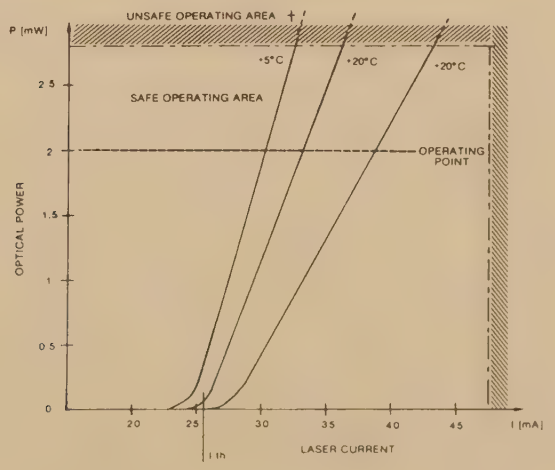


Figure 4.4 Power Output vs. Laser Current

Figure 4.4 indicates the typical graph for a laser diode used in the Model 1710-1300-X/1720-1300-X. The laser begins emitting light at the threshold point and then small current changes produce large optical output changes. If the laser is operated at a constant current, slight temperature changes can lead to such significant power deviations that accurate measurements cannot be made. In the worst case, when temperature drops, the laser diode will burn out, in other words, the optical power would increase to a level where the end surfaces (mirrors) of the laser start to melt. (A laser typically has many hundred times the energy stored in its cavity then it actually releases and most of the enery is located near the mirrors).

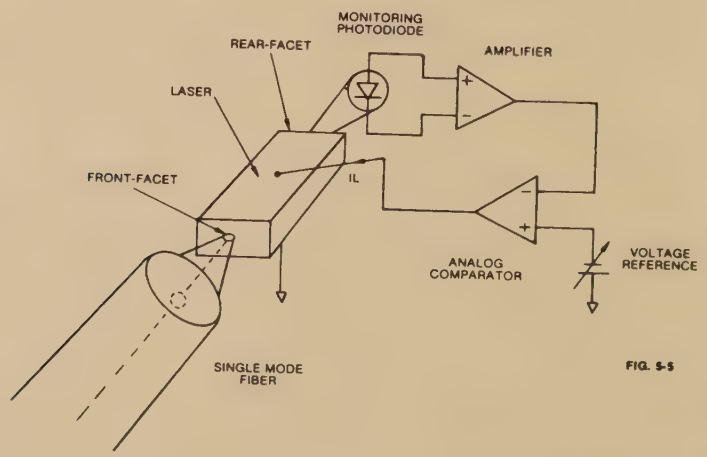


Figure 4.5 Principle of an Optical Feedback Laser Driver

To overcome these problems, the 1710/1720 Series use an optical feedback system to regulate the laser current. A

monitoring photodiode measures the power output at the back side of the laser. This signal is amplified and compared with an electronic voltage reference. The signal differential regulates the laser current.

4.2 Block Diagram

The block diagram shows how the laser source operates. The laser diode is driven by the laser diode driver circuit. In the following, the functional blocks are explained.

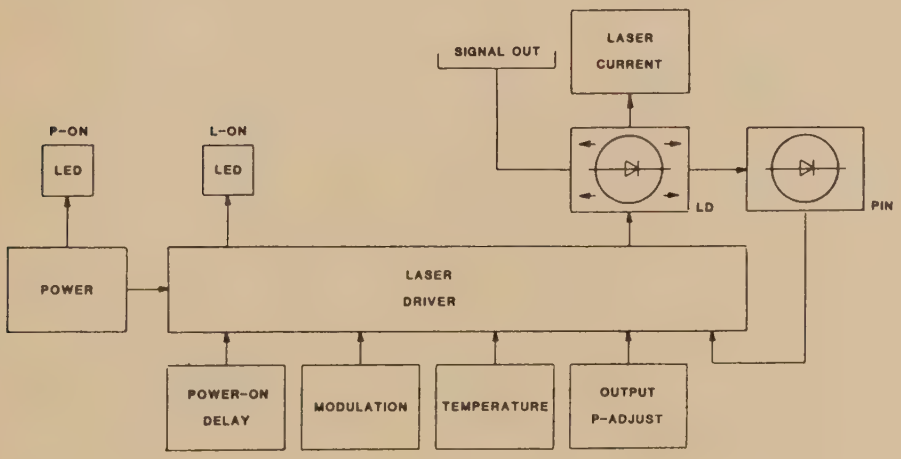


Figure 4.6 Block Diagram of Laser Driver

4.2.1 Power

The red LED on the front panel lights up, whenever the power is on. For operator safety, every PHOTODYNE mainframe for the 1710/1720 modules has a key switch. The 1710/1720 modules use less than 50 mA (total current on 5V).

4.2.2 Power-On Delay

For operator and laser safety the laser is active 5 seconds after power-on. The time delay is determined by an RC time constant. The yellow LED on the front panel indicates whenever the laser is on.

4.2.3 Modulation

All the 1710/1720 Laser Source Modules have a modulation input. Laboratory type instruments, such as the mainframe 2230XR or 7600XR, have an external modulation input which is directly connected to the modulation input. For more information, see "optical power modulation" (3.3).

4.2.4 Temperature

A protection circuit will disable the laser if the temperature inside the case exceeds a specified high level. The laser will be active, if the temperature is below 45^{o}C. The laser will be turned off when the temperature is over 50^{o}C.

4.2.5 Output Power Adjust

A potentiometer allows the user to vary the optical output power. Turn the current adjust fully clockwise to measure full output power. The laser power can be varied over an approximately 10dB range only, since the laser should not be operated below threshold. Note, the maximum output power depends on the fiber diameter, fiber NA, refractive index of the fiber and the quality of the connector interface.

4.2.6 Laser

The 1710-0850/1720-0850 series have an AlGaAs laser diode emitting light at typical 850 nm wavelength. The 1710-1300/1720-1300 and 1710-1550/1720-1550 series have an InGaAsP/InP double heterostructure laser diode. The lasers emit light from both facets. The light from one facet is coupled with a precision optics to the fiber optic connector on the front panel. The light emitted from the second facet is monitored by a photodiode.

4.2.7 Photodiode

To maintain good stability the Model 1710/1720 uses an optical feedback loop in the circuit design. The laser emits light from both front and rear mirror surfaces. The light from the rear mirror impinges on the monitoring photodiode in the circuit. As both front and rear

beams are in constant proportion, the photodiode output current is used as an automatic feedback control of the drive current to the laser.

4.2.8 Signal Out

Several output fiber optic connectors can be supplied as options. Most connectors are suitable for multimode and single-mode fiber. There is no wear-out of the fiber optic connector or the source module connector because there is no mechanical contact between fiber end and coupling lens.

The dust cap protects the laser connector from incoming dust. It is recommended to cover the output port at all time to protect the user from exposure to laser radiation.

4.2.9 Laser Current

When a module is plugged-in to a PHOTODYNE mainframe, such as the Model 2230XF Power Meter, the laser current can be displayed and the power can be accurately adjusted with the potentiometer on the front panel. The power may be varied over a 10dB range.

NOTE: Since the laser is controlled in a closed loop circuit, the drive current may be different for the same power out under varying environmental conditions.

4.2.10 9 Pin D-Connector

The 1710/1720 Laser Source Modules have a 9 PIN D-CONNECTOR interface. The male connector is on the module, the female connector is on the mainframe.

PIN 1:	Current Sense:	Outputs a Voltage 10 mV/mA
PIN 2:	Power Supply:	+ 5V ± 5% (Key Lock)
PIN 3:	ON/OFF Modulation:	logic 1 signal turns laser off logic 0 signal or open turns laser on
PIN 4:	Wavelength:	1V/um
PIN 5:	Identification Pin:	Is connected to GND on Laser Modules
PIN 6:	N/C	
PIN 7:	N/C	
PIN 8:	N/C	
PIN 9:	Power Supply:	GND

5. LASER SOURCE MODULE, MAINFRAMES AND ACCESSORIES

5.1 Laser Source Module

Central Wavelength ±20nm

1710-0850-B	LASER SOURCE	850nm Amphenol 905/906 SMA
1710-0850-G	LASER SOURCE	850nm Diamond/Interoptics GFS-3/HMS-3
1710-0850-H	LASER SOURCE	850nm Holtek 38000/Stratos 430
1710-0850-J	LASER SOURCE	850nm Seiko FC/D3 (NTT)
1710-0850-M	LASER SOURCE	850nm Siemens DIN/Diamond
1710-0850-N	LASER SOURCE	850nm NEC D4
1710-0850-T	LASER SOURCE	850nm AT&T ST
1710-0850-W	LASER SOURCE	850nm AT&T Biconic
1710-1300-B	LASER SOURCE	1300nm Amphenol 905/906 SMA
1710-1300-G	LASER SOURCE	1300nm Diamond/Interoptics GFS-3/HMS-3
1710-1300-H	LASER SOURCE	1300nm Holtek 38000/Stratos 430
1710-1300-J	LASER SOURCE	1300nm Seiko FC/D3 (NTT)
1710-1300-M	LASER SOURCE	1300nm Siemens DIN/Diamond
1710-1300-N	LASER SOURCE	1300nm NEC D4
1710-1300-T	LASER SOURCE	1300nm AT&T ST
1710-1300-W	LASER SOURCE	1300nm AT&T Biconic
1710-1550-B	LASER SOURCE	1550nm Amphenol 905/906 SMA
1710-1550-G	LASER SOURCE	1550nm Diamond/Interoptics GFS-3/HMS-3
1710-1550-H	LASER SOURCE	1550nm Holtek 38000/Stratos 430
1710-1550-J	LASER SOURCE	1550nm Seiko FC/D3 (NTT)
1710-1550-M	LASER SOURCE	1550nm Siemens DIN/Diamond
1710-1550-N	LASER SOURCE	1550nm NEC D4
1710-1550-T	LASER SOURCE	1550nm AT&T ST
1710-1550-W	LASER SOURCE	1550nm AT&T Biconic

Central Wavelength ± 5nm

1720-0850-B	LASER SOURCE	850nm Amphenol 905/906 SMA
1720-0850-G	LASER SOURCE	850nm Diamond/Interoptics GFS-3/HMS-3
1720-0850-H	LASER SOURCE	850nm Holtek 38000/Stratos 430
1720-0850-J	LASER SOURCE	850nm Seiko FC/D3 (NTT)
1720-0850-M	LASER SOURCE	850nm Siemens DIN/Diamond
1720-0850-N	LASER SOURCE	850nm NEC D4
1720-0850-T	LASER SOURCE	850nm AT&T ST
1720-0850-W	LASER SOURCE	850nm AT&T Biconic
1720-1300-B	LASER SOURCE	1300nm Amphenol 905/906 SMA
1720-1300-G	LASER SOURCE	1300nm Diamond/Interoptics GFS-3/HMS-3
1720-1300-H	LASER SOURCE	1300nm Holtek 38000/Stratos 430
1720-1300-J	LASER SOURCE	1300nm Seiko FC/D3 (NTT)
1720-1300-M	LASER SOURCE	1300nm Siemens DIN/Diamond
1720-1300-N	LASER SOURCE	1300nm NEC D4

1720-1300-T	LASER SOURCE	1300nm AT&T ST
1720-1300-W	LASER SOURCE	1300nm AT&T Biconic
1720-1310-B	LASER SOURCE	1310nm Amphenol 905/906 SMA
1720-1310-G	LASER SOURCE	1310nm Diamond/Interoptics GFS-3/HMS-3
1720-1310-H	LASER SOURCE	1310nm Holtek 38000/Stratos 430
1720-1310-J	LASER SOURCE	1310nm Seiko FC/D3 (NTT)
1720-1310-M	LASER SOURCE	1310nm Siemens DIN/Diamond
1720-1310-N	LASER SOURCE	1310nm NEC D4
1720-1310-T	LASER SOURCE	1310nm AT&T ST
1720-1310-W	LASER SOURCE	1310nm AT&T Biconic
1720-1550-B	LASER SOURCE	1550nm Amphenol 905/906 SMA
1720-1550-G	LASER SOURCE	1550nm Diamond/Interoptics GFS-3/HMS-3
1720-1550-H	LASER SOURCE	1550nm Holtek 38000/Stratos 430
1720-1550-J	LASER SOURCE	1550nm Seiko FC/D3 (NTT)
1720-1550-M	LASER SOURCE	1550nm Siemens DIN/Diamond
1720-1550-N	LASER SOURCE	1550nm NEC D4
1720-1550-T	LASER SOURCE	1550nm AT&T ST
1720-1550-W	LASER SOURCE	1550nm AT&T Biconic

Consult the factory for other source and termination requirements.

5.2 Mainframes

9XT Stabilized Source Mainframe

* Stabilized Driver for 1710/1720 Laser Source Module

2230XF/XR Loss Test Set

* Driver for 1710/1720 Laser Source Module
* Laser Current Measurement
* External input for Square Wave Modulation

2275XQ Programmable Power Meter

* Driver for 1710/1720 Laser Source Module
* Built-in Germanium Detector
* Laser Current Measurement
* Built-in IEEE-488 Interface
* Internal Square Wave Modulation

7600XR Multiport Source Mainframe

* Driver for up to six 1710/1720 Laser Source Modules
* Laser Current Measurement
* Internal 1kHz and 2kHz Modulation
* External input for Square Wave Modulation

5.3 Cable Assemblies

1230-010-G	SM Cable Assembly, 9/125um, Diamond/Interoptics
1230-010-J	SM Cable Assembly, 9/125um, Seiko FC/D3
1230-010-M	SM Cable Assembly, 9/125um, Siemens DIN/Diamond
1230-010-N	SM Cable Assembly, 9/125um, NEC D4
1230-010-W	SM Cable Assembly, 9/125um, AT&T Biconic
1230-050-B	Cable Assembly 50/125um, Amphenol 905/906 SMA
1230-050-G	Cable Assembly, 50/125um, Diamond/Interoptics
1230-050-J	Cable Assembly, 50/125um, Seiko FC/D3
1230-050-M	Cable Assembly, 50/125um, Siemens DIN/Diamond
1230-050-N	Cable Assembly, 50/125um, NEC D4

1230-050-W Cable Assembly, 50/125um, AT&T Biconic

1230-062-T Cable Assembly, 62.5/125um, AT&T ST

1230-100-B Cable Assembly, 100/140um, Amphenol 905/906 SMA

5.4 Accessories

3015 IR-Indicator, 850nm - 1300nm

3016 IR-Indicator, 1550nm

3017 Laser Key

3018 Trimmer Screwdriver

6. SAFETY CONSIDERATIONS

6.1 General

Operator safety has been a prime concern in the design of the Model 1710/1720 Laser Source Module. Standards for safety established by the U.S. Government have been carefully adhered to.

6.2 Laser Safety

Inside each of the 1710/1720 series of plug-in source modules is a solid state semiconductor laser. The operating laser wavelength window is given in the basic model number. For instance, #1710-1300-W, is a 1300nm semiconductor laser with an integral AT&T biconic connector for optical fibers. All laser products sold in the United States must conform to performance and safety regulations established by the Center of Devices and Radiological Health (CDRH). The Model 1710/1720 conforms to the applicable requirements of 21CFR subchapter J at date of manufacture. The Model 1710/1720 Laser Source Modules are class I laser products. Following the procedures described in this manual, the modules can be operated safely.

CAUTION:

USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

In particular, if a 1710/1720 series plug-in module is opened, and the electronic circuit board inside is modified in any way, radiation may be emitted which exceeds class I, and could cause damage.

CAUTION:

THE USE OF OPTICAL INSTRUMENTS WITH THIS PRODUCT WILL INCREASE EYE HAZARD.

6.3 Acceptance Test Procedure for Laser and Laser Driver on a 1710/1720 Series Laser Plug-In Module

1. Equipment required

   PHOTODYNE 88XLC Series

   PHOTODYNE Model 550 Sensor Head

   Mechanical Fixture defining a 5mm diameter measuring aperture, 14.2cm from the fiber optical connector output.

2. Equipment Setup

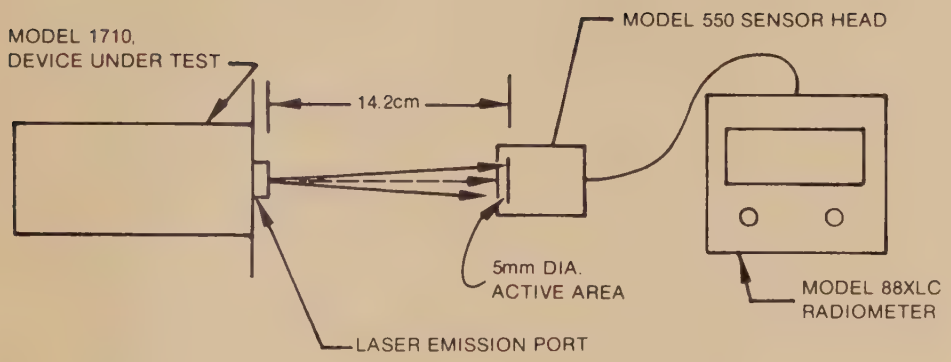


Figure 6.1 Measurement Setup

3. Procedure - fiber/connector output calibration

a) Setup the equipment as in the test setup above.

b) Turn on power to the 88XLC.

c) Turn on power to the device under test.

d) Record value of power output on individual data sheet.

e) Reject unit if the optical power from Model 1710/1720 under test exceeds the following power levels :

WAVELENGTH (+/-20nm)	MAXIMUM POWER
780nm	35uW
820nm	53uW
850nm	60uW
1300nm	155uW
1550nm	630uW

4. Procedure - data sheet for calibration results

   a) Each Model 1710/1720 has a data sheet on file (see page 6-5) at PHOTODYNE, of calibration data taken in step 3 above.

5. Procedure - label verification

   a) Verify that the following label are securely affixed at the module cover.

Figure 6.2 ID-Label

THIS PRODUCT CONFORMS TO THE APPLICABLE REQUIREMENTS OF 21 CFR SUBCHAPTER J AT DATE OF MANUFACTURE.
MANUFACTURED:
DECEMBER 1986
CLASS I
LASER PRODUCT
PHOTODYNE INC.
NEWBURY PARK,CA 91320

Certification Label

SAFETY DATA SHEET FOR MODEL 1710/1720

Model No: _____

Serial No: _____

Date: _____

Operator: _____

Peak Wavelength: _____ nm

Laser Emission Calibration

Output Power: _____ uW

Maximum allowed Output Power

WAVELENGTH (+/- 20nm)	MAXIMUM POWER
780nn	35uW
820nm	53uW
850nm	60uW
1300nm	155uW
1550nm	630uW

Accept:_____

Reject:_____

Figure 6.3 Safety Data for Model 1710/1720

6.4 Calibration Procedure for PHOTODYNE Model 550 Sensor Head and Transferring Calibration from N.B.S. DR-11

1. Model 88XLC radiometer, calibration traceability to N.B.S.

   a) N.B.S. silicon detector DR-11.

2. Equipment required

   a) DR-11 N.B.S. silicon detector

   b) Working standard silicon photodiode

   c) 850nm light source

   d) Keithly 481 picoammeter

   e) Keithly Model 291 current source

   f) Model 88XLC current measuring radiometer

3. Procedure for transfer calibration

   a) Hook up light source output so that all light is collected by large area silicon photodiode working standard.

   b) Measure current produced in working standard photodiode from light source.

   c) Using calibration factor from N.B.S. (DR-11), calculate total light emission from source.

   d) Hook up light source output into Model 550 sensor head.

e) Record current produced by 550 sensor head.

f) Using results of d, calculate calibration factor of Model 550 sensor head in amps of current out per Watt light in.

g) Calibrate 88XLC current measuring radiometer using Keithly Model 291 current source.

7. MAINTENANCE AND REPAIR

7.1 Maintenance and Repair

PHOTODYNE INC. maintains a complete repair and calibration service as well as a standard laboratory in Newbury Park, California. Should your module need any repair or calibration, please contact your local field representative or PHOTODYNE Headquarters directly before returning the instrument.

7.2 Performance Verification

The Model 1710/1720 is a plug-in Module and its performance can be tested by plugging it in a mainframe and verify its proper performance. In the following, a step by step procedure is described.

1) Plug Model 1710/1720 Laser Source Module in a mainframe, such as 9XT, 2230XF/XR, 2275XQ or 7600XR.

2) Attach a multimode fiber (50/125um, 0.2NA) to the optical connector on the module on one side, and to a photometer (i.e. 88XLC, 1750 Modules) on the other side.

3) Turn on the instrument and the "XMTR" on the mainframe (see Instruction Manual of the mainframe instrument).

4) Turn the laser key to power the 1710/1720 Module. The red LED on the front panel should light up now.

5) Wait 5 seconds until the yellow LED on the front panel lights up. Now the laser is active.

6) Turn the potentiometer "P-Adj" on the front panel fully clockwise up to measure maximum output power. The reading should be between 1mW and 1.9mW for a multimode fiber (50/125um, 0.2NA). Note the maximum output power depends on the connector interface and the type of fiber. If the reading is too low, disconnect the fiber from the module and reconnect it.

7.3 Calibration

It is recommended that all the repairs and calibration be done by PHOTODYNE factory personnel or authorized and trained service personnel. For safety reasons, there should be no changes or readjustments to any of the internal circuitry which could possibly affect the laser output power.

Calibration of the Model 1710

PHOTODYNE maintains its own standard laboratory and all instruments are calibrated and traceable to the National Bureau of Standards. For traceability and standards

transfer please refer to Section 7.3.

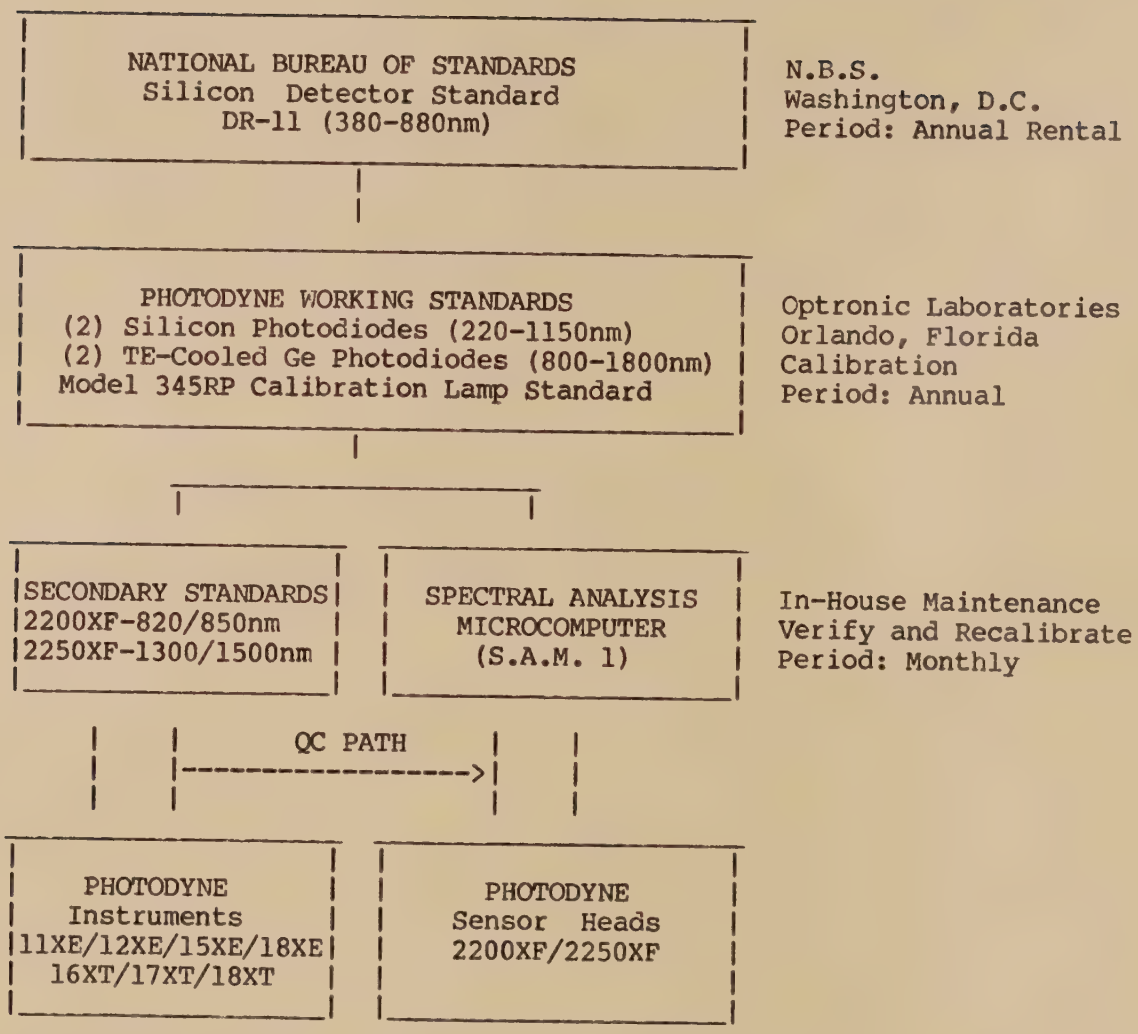
The Model 1710/1720 was accurately calibrated at time of shipment and maintains the accuracy within the specified tolerances. Should recalibration be necessary it is recommended that the unit be sent back to PHOTODYNE Headquarters.

NOTE:

PHOTODYNE DISCLAIMS ANY WARRANTY OR LIABILITY ONCE THE MODULE COVER HAS BEEN REMOVED.

7.4 Statement of Spectral Calibration

The Spectral accuracy and calibration of all PHOTODYNE products are traceable to the National Bureau of Standards through equipment which is calibrated at planned intervals by comparison to certified standards.



Working Standards

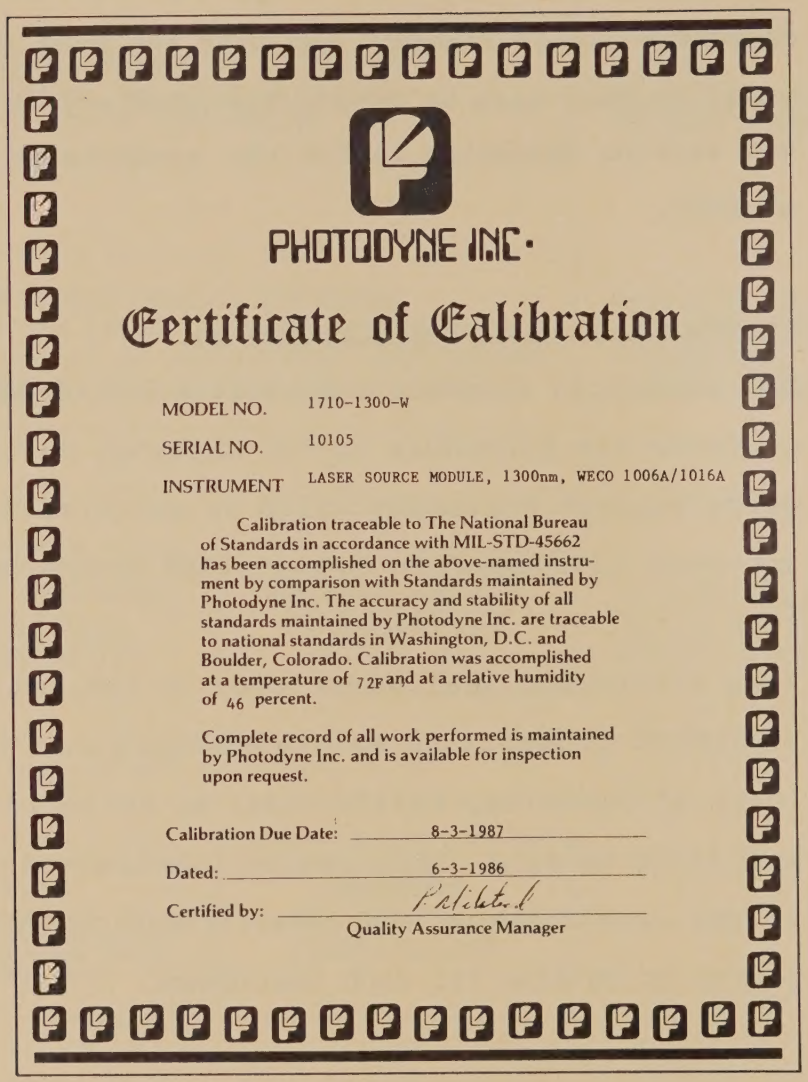
PHOTODYNE working standards are special photodiodes selected for low noise and stability. These units are sent to Optronic Laboratories, a certified commercial standards laboratory which provides a complete spectral analysis of detector responsivity. When returned to PHOTODYNE, these devices are compared against an N.B.S.

Detector Responsivity and Intercomparison Package (DRIP). PHOTODYNE always requests and uses the same unit - DR-11. DR-11 is then used to verify the accuracy of the old and new working standards within the measurement uncertainty of SAM1.

7.5 Statement of Electrical Calibration

The electrical accuracy and calibration of all PHOTODYNE products are traceable to the National Bureau of Standards through equipment which is calibrated at planned intervals by comparison to certified standards.

Each electronic instrument used in the calibration of PHOTODYNE products is maintained by E.I.L. Instruments (City of Commerce, California). At periodic intervals, specified by E.I.L. Instruments, instruments are called in for recalibration and recertification. A calibration report is on file for each instrument.



PHOTODYNE INC.

Certificate of Calibration

MODEL NO. 1710-1300-W

SERIAL NO. 10105

INSTRUMENT LASER SOURCE MODULE, 1300nm, WECO 1006A/1016A

Calibration traceable to The National Bureau of Standards in accordance with MIL-STD-45662 has been accomplished on the above-named instrument by comparison with Standards maintained by Photodyne Inc. The accuracy and stability of all standards maintained by Photodyne Inc. are traceable to national standards in Washington, D.C. and Boulder, Colorado. Calibration was accomplished at a temperature of 72F and at a relative humidity of 46 percent.

Complete record of all work performed is maintained by Photodyne Inc. and is available for inspection upon request.

Calibration Due Date: 8-3-1987

Dated: 6-3-1986

Certified by: _____

Quality Assurance Manager

Figure 7.1 Sample of Certification of Calibration

www.manualsplus.com
1028991

PHOTODYNE INC.
3760 Calle Tecate
Camarillo, California 93010 U.S.A.
Phone: (805) 388-8378
TELEX: 18-1159 FAX: 1-805-499-9311

PHOTODYNE EUROPE INC.
P.O. Box 856 2900 AW Capelle A/D Yssel, Holland
Phone 31-10-4583055 Telex 23746 OCOP Fax: 31-10-4586414

©1988 Photodyne, Inc. Printed in U.S.A.

SE Laboratories
LOC: DD2
MAN - 05542